

~~Revised and enlarged~~

with Dr. Blakiston's Comments

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A LECTURE ON  
The Diffusion of  
SCIENTIFIC KNOWLEDGE,  
IN  
LARGE TOWNS.

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A LECTURE ON  
*The Diffusion*  
OF  
SCIENTIFIC KNOWLEDGE,  
IN  
LARGE TOWNS:

DELIVERED  
TO THE MEMBERS OF THE BIRMINGHAM  
*Philosophical Institution,*

DEC. 18, 1837.

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*Second Edition.*

LONDON:  
SIMPKIN, MARSHALL, & CO., STATIONERS' HALL COURT:  
ALLEN & LYON, BENNETTS HILL, BIRMINGHAM.

BIRMINGHAM:  
PRINTED BY ALLEN AND LYON,  
BENNETT'S HILL.

R35738

# LECTURE

ON THE

## DIFFUSION OF SCIENTIFIC KNOWLEDGE IN LARGE TOWNS.

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There are certain periods in the lives of all men, when it would seem to be no less advantageous than proper to review their past actions and scan their present position, for the purpose of examining whether they have been drawn aside from those principles which their judgment has approved, and whether a change of situation may have called for new duties which it is important they should not neglect. This self-examination, which has been considered by the wise and good of all ages as wholesome and necessary to individuals, is no less so to public bodies or classes of society, and would seem to be especially required on the part of the influential inhabitants of this town, at a time when it is on the eve of becoming the centre of inland communication, and when we are called upon to prepare for the reception of a most distinguished scientific body, which may be expected at no distant period, to hold its meeting here. Allow me then, for a few moments, to direct your attention to the past and present state of this place,

In reviewing the events of the last thirty years, we cannot but be struck with the extensive changes that have taken place. Engine after engine has been erected, manufacture after manufacture introduced. Places of public worship have been multiplied, and splendid edifices have risen within the town itself, while its environs have become studded with elegant and substantial dwellings. The abodes, too, of the humbler classes have undergone material improvement;

so that, as regards their ventilation, cleanliness, and convenient arrangement, they vie with, if they do not surpass, those of any other town containing an equal population.

These are strong proofs of the increase of riches and prosperity. Immense wealth may not have been accumulated by individuals, but (which is better) there has been a large addition to the number of those, who, by their industry and talents, have raised themselves to independence and comfort. The number and extent of the societies which have risen up for the encouragement of the arts or the advancement of science, show that taste and refinement have in some measure kept pace with the increase of comfort and wealth.

Satisfactory as is the improvement in these respects, it is less important than that which has taken place in the moral character of the working classes. Within the memory of many, their meetings were characterised by a fearful spirit of violence and outrage. With two exceptions, however, one of which, I am sorry to say, was recent, and which cannot be too deeply regretted or too strongly condemned, no loss of property has resulted from their assemblage in periods of excitement or distress, during the last thirty years. (a) This improvement in the feelings and habits of the labouring classes is further shown by the increase in the amount of deposits in the Savings' Bank, and by the number and extent of the provident institutions now existing—proofs the most conclusive that could be adduced.

It would be an interesting task to trace the various causes that have concurred to produce such beneficial effects as those which I have enumerated; but it would be foreign to my present purpose to do so: one or two, however, of the most obvious must not be omitted. It will at once be acknowledged by all, that the great increase of our

(a) Recent circumstances might seem at first sight, to prove that this opinion was not well founded, but they will, I think, be found to confirm it. Persons are well aware that the late diabolical destruction of property was the work of a few thieves, and of a mob allowed to lash itself into madness without opposition.

The wonder is that the unceasing efforts of blood-thirsty agitators should have produced so little effect among the working classes of this town, who, unmoved by their exciting addresses, still retain that respect for the rights of others, which their intelligence and good sense shews them to be necessary to the well-being of society: and although they may entertain extravagant notions regarding the extension of political power, yet I do not believe they would resort to violent measures to carry their point, or that they could be induced to raise a finger against the life or property of others under any circumstances.

manufactures and riches, has mainly and directly flowed from the improvements in the Steam Engine effected by the late Mr. Watt, whose name will always be had in honour among all who are capable of appreciating the benefits derived from his persevering ingenuity. By this means the natural products of the neighbourhood, Coal and Iron, were at once turned to a much larger account than they had ever been. But this direct cause arose out of another more extensive in its operations, I mean the diffusion of knowledge. At the time he made the discovery which led to his improvements in the Steam Engine, James Watt was residing as a mathematical instrument maker at Glasgow, where the diffusion of scientific knowledge had made some progress, and where he had come within its range, and had thus been prepared for making that discovery, which led to such stupendous results.

Again, it is well known that for many years the children of the working classes of this town have been highly favoured with the means of religious instruction; and this will be said to be the chief cause of the moral improvement that has taken place amongst them. Unquestionably it is. Religion is the highest branch of knowledge, that which supplies us in the pages of Revelation with a sure guide during life and a bright hope in death. And here I cannot withhold the meed of praise from those persons who, at an early period in the history of Sunday Schools, were so deeply impressed with their importance and utility, that they established them in this town on an extensive scale. To the end of time their beneficial effects will be felt.

The history of man in all ages and countries forbids our attributing the happy change I have alluded to as having taken place in the conduct of the working classes, when assembled in periods of excitement or distress, to the counsels or restraining influence of others; for even the most heroic self-devotion, and the most fervid eloquence, have failed to allay the fury of an excited populace devoid of education. No: the cause is to be found in the moral improvement which has taken place among the mechanics themselves—the result of education; which while it has enabled them better to discriminate between sophistry and truth, and between declamation and argument has assisted them to restrain their passions, and has taught them to respect the laws.



But the position of individuals or communities is not merely to be judged of by what it has been, but by what it ought to be ; and we must constantly endeavour to bring it nearer and nearer to such a standard ; enquiring whether additional exertions may not be required in order to secure and to increase the advantages already attained. Thus, the present state of this town looks well when compared with the past. But is it not still very far from what we could wish it to be ? Has the increase in the number of places of public worship kept pace with that of the population ? Are the scientific institutions conducted on a scale suited to so large and important a town, and furnished with well-stored museums, accessible to all classes ? Are we surrounded by airy and pleasant public parades, in which the mechanic and his family can enjoy wholesome and innocent recreation ? Do not we still encounter profligacy and drunkenness in our streets ? and do not their appalling effects fall under our daily observation ? Is not the town, at this moment, swarming with the victims of improvidence ? and are not a large number totally unacquainted with a knowledge of even reading and writing, the tools necessary for working out mental improvement ? There remains obviously much to be done, to which what has already been accomplished bears but a small proportion.

I have alluded to the probability of our town being visited before the expiration of two years by an assemblage of eminent men connected with the British Association for the Advancement of Science. While they will contemplate with interest our growing manufactures and our stupendous railroads—while they gaze with delight on the architectural beauties displayed in two of the most chaste and elegant buildings of the age, and while they will recall to their minds the philosophical labours of Priestley and of Watt—they will not fail to enquire what steps we are taking to elevate the mass of the population below us by the diffusion of the knowledge which has already been acquired, and what facts we are collecting, which may serve for the discovery of new truths in the various departments of science.

I have said, too, that this town is on the eve of becoming the centre of inland communication, by the completion of that stupendous work, the Railway between Liverpool and London ; and this there can be little or no doubt, will soon be followed by others which will ramify



to all the principal points of the island. It is impossible to hazard a conjecture as to the whole effect this may have upon our town, or to assign a limit to the importance which it may thus attain. At this moment the eyes of all are directed towards it; and strangers will soon flock in from various quarters, and they also will enquire into the progress we are making in the work to which I have alluded.

In the slight sketch which has thus been drawn of the past and present state of this town, the effects of the diffusion of knowledge may be clearly traced in the improvements which have taken place, and we may therefore naturally expect that the future advancement of civilization may be much hastened by the same means. The importance of this subject, then, coupled with the fact that we are about to be put upon our trial before a tribunal of Science, renders any apology for bringing it under your notice on this occasion unnecessary. It may be said that none *now* dispute the utility of knowledge, either on moral or political grounds. But, alas! we do not always practice what we know to be useful and right; few deny the authority of Revelation, but many neglect to follow its injunctions. We require "line upon line, and precept upon precept."

There are some amongst us who have long felt the importance of this subject, and have been long labouring to elevate the moral feelings, and improve the minds and habits of the working classes. I cannot hope to teach such persons, but I may perchance strike a corresponding chord in their minds, and recall by association long forgotten trains of pleasurable feelings, while I enlarge upon the *advantages, duty, and means, of diffusing scientific knowledge.*

Among the *advantages* arising out of the diffusion of knowledge those which are attendant on religious instruction are too obvious and too fully acknowledged to require any demonstration. The knowledge of the will of Him to whom we owe all our blessings, is indeed an advantage which puts all others far out of the reach of comparison. It is not, therefore, as undervaluing its importance, that I do not now dwell more particularly upon this subject, nor would I forget for one moment, nor have any who do me the honour to listen to me forget, that Science is most useful and most honourable when she appears as the hand-maid of Religion. In this connection, and in this subordination, so to speak, I proceed to treat of scientific know-

ledge, as explaining the phenomena of nature and the duties of society.

The manual labour required in most trades may be performed by persons perfectly unacquainted with the laws of science, and even some kinds of mental labour may be accomplished by the same class of persons, as has been well shewn by Mr. Babbage, in his work on the "Economy of Manufactures." Those, however, who arrange and plan the work must know something more; and those who invent processes or machinery must be acquainted (practically at least) with those laws of science on which their conclusions depend. Thus, the most eminent mathematicians formed a section for the purpose of determining the best formulæ for the famous French Logarithmic Tables; these formulæ were then delivered to a second section, tolerably well versed in mathematics, who, having turned them into numbers, handed them over to the last section for completion by simple addition. It is evident, then, that for all but the commonest purposes, scientific knowledge must be advantageous. There is not a domestic process, however simple, in which some scientific principle is not involved, and in which, consequently, an acquaintance with such principles may not prevent an error or suggest an improvement. A farmer having once manured his land with lime, was surprised to find a decrease in its produce. He mentioned the circumstance to a gentleman acquainted with chemistry, who, having procured some of the lime, submitted it to analysis, by which means he discovered that it had been made from magnesian limestone. The cause of the failure in the produce of the land became immediately apparent, magnesia being injurious to the growth of vegetable substances on some soils. The great French chemist, Lavoisier, took a quantity of land into his own cultivation, and having analysed the soil, and applied such substances to improve its quality as his chemical knowledge suggested, he succeeded in doubling its produce in a short time.

'Thus, were the knowledge that *now exists* generally diffused, and did it penetrate to the lowest grades of society, we might expect that the land of the farmer would become more productive, and that the goods of the manufacturer would be better made; in short, that all those articles which minister to the wants and comforts of man would be produced of a better quality, and in greater abundance, than they are at present.

Again, the diffusion of present knowledge may be expected to lead to *new discoveries*. By this means the number of philosophical enquirers is increased; for although the desire for knowledge may at first be small, yet it soon increases, and finds no such gratification as in the discovery of new truths. Some persons, however, have a natural aptness to invent; and were they not made acquainted with what is already known, they would be continually directing their thoughts and efforts into channels which had been previously explored. It is by no means uncommon to witness the display of very great ingenuity and talent on the part of a mechanic, in the invention of a process, or a piece of machinery, which has already been some time at work in a distant part of the country. Such a misdirection of talent and industry would be prevented by the diffusion of scientific knowledge. But, perhaps, its greatest value consists in its preparation of the working classes for becoming discoverers. To use the language employed in the preliminary treatise of the Library of Useful Knowledge, "It gives every man a chance, according to his natural talents, of becoming an improver in the art he works at, and even a discoverer in the sciences connected with it. He is daily handling the tools and materials with which new experiments are to be made; and daily witnessing the operations of nature, whether in the motions and pressure of bodies, or in their chemical action on each other. All opportunities of making experiments must be unimproved, all appearances must pass unnoticed, if he has no knowledge of principles; but with this knowledge he is more likely than any other person to strike out something new which may be useful in art, or curious and interesting in science. Very few discoveries have been made by chance or by ignorant persons; much fewer than is generally supposed." The writer, after adducing proofs of this, and referring to discoveries made by persons of competent knowledge, who were in search of them, adds: "In so far as chance has any thing to do with discovery, surely it is worth the while of those who are constantly working in particular employments, to obtain the knowledge required, because their chances are greater than other people's of so applying that knowledge as to hit upon new and useful ideas; they are always in the way of perceiving what is wanting, or what is amiss in the old methods; and they have a better chance of

making the improvements. In a word, to use a common expression, they are in the way of good luck, and if they possess the requisite information, they can take advantage of it when it comes to them." It is thus that many great inventions have been made, and that many great men have raised themselves from very humble stations—Arkwright, John Hunter, and Sir Humphrey Davy are striking examples. Is it not reasonable to expect that such instances will be multiplied, as scientific knowledge is more extensively diffused? This town contains a vast number of artisans whose superior intelligence and activity have raised them above their fellows. Such men are exactly in a situation to profit by any scientific information which may be thrown in their way. Endowed by nature with quickness of apprehension, receiving fair wages, and not so fatigued with their daily occupation as those occupied in the drudgeries of the manufactories, they have some time, money, and talent, to bestow upon the cultivation of science. From the labours of such men as these much good may arise to our town, and much evil may be warded off from its trade, for from them may originate such improvements in machinery and in the economy of manufactures, as shall enable us to retain that place in the great markets of the world which we have so long held, but from which, some think, we may be one day driven by foreign competition.

But scientific knowledge, in penetrating to the working classes, must pass through that of manufacturers; and it is to be hoped, that, like light traversing diaphanous bodies, it may leave some of its rays behind it; for among this class have arisen great discoverers. Two elementary substances, Iodine and Bromine, were respectively discovered by a manufacturer of saltpetre and a working chemist; and it was Dolland, the optician, who finding that a lens made of one kind of glass decomposed the white light that passed through it into its primitive colours, the distances between each of which were greater than when it passed through one made of another kind of glass, formed such a combination of these different lenses, that the light which had been decomposed by some was recomposed by the others, with only a partial loss of the refraction, by which the apparent sizes of objects are increased. He thus succeeded in producing magnifying glasses through which the light passed to the eye in a



state of achromatism, *i. e.* devoid of colour; a circumstance which Newton had supposed could never take place. The French are fully alive to the advantages which must result from their manufacturers receiving a scientific education. There are, in Paris, no less than three public laboratories, furnished with the most costly apparatus, and superintended by the first chemists of the age, which are open to all those students who by their industry and good conduct have rendered it probable that they will make a good use of such advantages; and in the private laboratories of that city are to be seen numerous students who are destined for those trades in which a knowledge of chemistry may be in the remotest degree useful. (*a*) The most brilliant examinations in chemistry are said to be passed by young men in this class of embryo manufacturers. A country which thus holds out encouragement for the cultivation of science by all classes, not merely in the one department to which I have more especially alluded, but in all, may well boast of having raised many philosophers from the humblest ranks of life.

We have now to notice another advantage arising from the diffusion of knowledge—the improvement of the mind, feelings, and habits. This is an effect which knowledge can scarcely enter the mind without producing in some degree; at least, the exceptions to such an effect are rare. While there are many whose talents and acquirements may be placed on a level with those of Voltaire, there are few, it is to be hoped, by whom they are used for such vile purposes as were those of that bad old man. The inhabitants of large towns are strongly tempted to spend their leisure hours in frivolous amusement or noisy revelry. Fatigued with the labours of the counting-house or the workshop, they too often seek for relief in such pursuits; but could they be induced to have recourse to the stores of science, how great an advantage would be gained! For an account

(*a*) Many persons are of opinion that a good opportunity now presents itself, of converting the temporary display of models, machinery, and specimens illustrative of manufacturing processes, which has been prepared for the inspection of the members of the British Association into a permanent exhibition. Should this be effected, arrangements might then be made for the delivery of courses of lectures on the application of science to the arts and manufactures, and thus the way might be prepared for the establishment of a NATIONAL SCHOOL OF PRACTICAL SCIENCE. I trust shortly to be able to show that Birmingham is on many accounts well calculated to be the seat of such an establishment, and in conjunction with others to prepare a plan for its formation.

of its pleasures, I would refer them to the Preliminary Treatise of the Library of Useful Knowledge; and strange indeed must be the constitution of that mind which cannot find something to its taste there. In acquiring knowledge man gains power both over matter and mind. It makes the elements minister to his use, as was forcibly pointed out by your President in his late admirable lecture; and in addition to the instances adduced by him, I might tell you that it has made a few pounds of water tear up by the roots the largest trees, and exert a pressure limited only by the strength of the materials of which the engine (Bramah's press) is constructed; and which was also the invention of a manufacturer. This has been done by the application of the principle that fluids exert an equal pressure in all directions, owing to the mobility of their particles. But knowledge endows man with power of another kind. It tends to moderate his passions, and aids his intellectual faculties in asserting that superiority over his animal propensities which his CREATOR intended they should maintain.

Nor is Science limited to the explanation of the laws of nature, but embraces also, in subordination, as I have said, to Religion, those which should regulate society. By this branch the lower orders are taught the absolute necessity for the existence of different classes of society, and the duty incumbent upon those who are not possessed of the accumulated fruits of industry, to provide for their own wants, alike present and prospective, by the labour of their own hands. Hence they are induced to attach themselves to Provident Institutions, calculated on sound principles, with a view of providing against the necessities of sickness and old age. The beneficial effects produced upon their character by the independence thus engendered are truly astonishing. They learn to respect themselves, and feel that they have a stronger interest in the preservation of social order. No longer,—if I may borrow without irreverence the language of Holy Writ,—no longer “tossed to and fro by the sleight of men, and cunning craftiness whereby they lie in wait to deceive,” they do not run after changes in the vague hope of bettering their condition, but advocate such only as their judgment has shown to be rendered necessary by the course of events, and such as they are prepared to recommend by solid argument rather than by physical force. “Every



hour," says Dr. Chalmers, "that a workman can reclaim from the mere drudgery of bone and muscle, will send him back to his workshop and his home, a more erect and high-minded individual."

It cannot be denied that the acquisition of scientific knowledge by mechanics has, in some instances, tended to unsettle their minds, and made them feel above their work; and on this account some have thought it impolitic to place it within their reach. The soundness of such an inference may, however, be doubted. As long as knowledge shall be imperfectly diffused, so long will those who have profited by it be raised above those who have not, and will think that the latter alone should be employed in the drudgeries of life; but when it shall have become more uniformly diffused, the difference between individuals will be less, and although there must always be inequalities, the pride of one will be held in check by the increased number of competitors with himself. Be this as it may, "the question is no longer," as has been justly observed by Lord Brougham, "whether or not the people shall be instructed—for that has been determined long ago, and the decision is irreversible—but whether they shall be well or ill taught—half-taught, or as thoroughly as their circumstances permit, and their wants require. Let no one be afraid of the bulk of the community becoming too accomplished for their superiors. Well educated, and even well versed in the most elevated sciences, they surely may become; and the worst consequences that can follow to their superiors will be, that to deserve being called their *bettors*, they too must devote themselves to the pursuit of solid and refined learning." Such an effect would prove an advantage of no mean order. When the upper classes are pushed on to higher mental cultivation by the elevation of those below them, they may be said to gather the fruits of their own sowing; so true is it that we can hardly benefit others without benefiting ourselves. Those of them who shall take upon themselves the office of instructors will derive an additional advantage; for the knowledge acquired in preparing ourselves for the instruction of others is most precious; because, in looking for the most simple and satisfactory explanation of difficulties, we must ourselves entirely overcome them, and view the subject in all its different bearings.

II. *The duty of diffusing scientific knowledge* is one which we owe

to our *Maker* and to *society*.—If we are grateful to our Maker for all the blessings he has bestowed upon us, is it not our duty to exalt Him among our fellow-creatures, and to make known His attributes of wisdom and goodness? which, while they are portrayed in the pages of Revelation, are similarly developed in every work of nature. “The heavens declare the glory of God, and the firmament showeth His handy work. Day unto day uttereth speech, and night unto night showeth knowledge. There is no speech or language where their voice is not heard.” We have all heard that voice; it has reached us in the still, calm hour of night, when we have gazed on the countless hosts of heavenly bodies, and our thoughts have been called upward to Him who hath set his glory above the heavens; but how has that voice deepened, how thrilling have been its tones, when we have contemplated those bodies through the glass of Science, and have learnt somewhat of their number and extent, of the almost immeasurable distances from each other at which some of them are placed, and of the wonderful manner in which they revolve, and retain their relative positions by the forces that the Creator has impressed upon them. Our faculties are unable to fathom the whole depth of the power and wisdom of God which these views partially display; and as to His goodness and Providential care of His creatures, there is not a common operation of nature in which they cannot be demonstrated by the explanation of its causes afforded by Science. Thus, in winter we observe the surface of the water becoming frozen, and after a certain time resuming its usual form. We are taught by Science that in this process there is an exception to a general rule, that bodies contract by the loss of heat; for, at about eight degrees above the freezing point, the water at the surface, in preparing itself for crystallisation, expands, and becomes lighter than that which is below it; in consequence of which it remains at the surface, and being a bad conductor of heat, it preserves the deep water in large rivers, lakes, and seas, from being frozen. From the same source we learn that the suddenness of the transition from heat to cold, and the converse, which might be expected to take place during sudden frosts and thaws, is moderated by the latent heat of fluidity being given out by the water as it crystallises into ice, and being re-absorbed when it returns to a state of liquefaction. In the Polar

regions, where it is necessary to the existence of the animals who inhabit them that their internal heat should be kept as much as possible from radiating to the surrounding cold substances, we find them provided with skins of such colours and materials as are most opposed to the passage of caloric; and the breasts of aquatic birds, which in swimming are constantly exposed to the action of fresh particles of cold water, are defended by thick down, which, owing to the extreme fineness of its feathers, proves almost a perfect non-conducting substance, and thus opposes a strong barrier to the abstraction of heat from the body. It is thus that science, in unravelling the mysteries of nature, unfolds to our view the wisdom, power, and goodness of the Almighty Creator. The harmony of nature is not the least extraordinary part of this view. The different phenomena seem to arise one out of the other, and to keep each other in equilibrio. The grand miracle is the formation of nature; the framing of that universal machine which regulates itself according to certain fixed laws that have been appointed for it. A watch of ordinary construction is a surprising and beautiful piece of mechanism, but with every great change of temperature it requires the regulating fingers of its owner. But there are others in the construction of which the principle of the unequal expansion of different metals by heat has been so introduced, that they regulate themselves, and will record the time in the course of a whole year to within half a second. Now, supposing that by means of such a chronometer, we had, under very perilous circumstances at sea been enabled to calculate our distance from land, and to steer our course with such nicety as to escape an almost inevitable danger, should we not be constantly talking of this instrument, exhibiting and explaining its construction to our friends, and referring to its maker as being, under Providence, the protector of our lives? Just so, with the same zeal, I mean, and in the same spirit, are we bound to unlock the book of Nature with the key of Science, and to circulate its truths far and wide amongst those for whose benefit it has been written, not less than for our own.

It is a duty we owe to *society*.—We are not isolated beings, but are dependant upon each other for every comfort in life. Hence there are certain duties which we owe to one another. That before



us may be deduced from the advantages which we have seen to arise from its proper performance. If from the diffusion of scientific knowledge flows an increase in those things which contribute to the comfort and happiness of all—if the social feelings be improved, and civilisation be raised to a higher point than that at which it had previously stood—then it is our duty to extend these advantages by every means within our power.

Society includes ourselves. The evils which result from ignorance are not confined to those persons with whom they originate, but radiate on all sides. Like some pestilential discases which are engendered, or, at least, are rendered malignant by a want of cleanliness, they may eventually scourge all classes of society. The Bohemian peasants rose up and murdered some of their nobles at the time the cholera appeared amongst them, under the belief that they had poisoned the springs of water. What a contrast to the conduct of the inhabitants of this town and of Edinburgh! who *all* united to employ the most rational means of prevention; and so successful were their efforts, that in this place the disease never obtained a footing; and in Edinburgh, although it broke out several times, it never spread to any great extent. It is a duty, then, we owe to *ourselves* to check the evils arising from ignorance, and to promote the blessings which flow from its removal, by diffusing widely the light of Science.

III. It now only remains for me to touch upon the *means of diffusing scientific knowledge*, which may be divided into *early education*, and the *instruction of adults*. Education cannot be commenced too early, if it be conducted upon proper principles. To control the passions, and cultivate the best feelings of the heart,—gently to exercise the memory, and at the same time to refrain from *forcing* the reasoning faculties of the infant,—should be the care of those who undertake their instruction. A warm heart and a sound head are alike required, with perfect command of temper, and unflinching firmness of purpose. Parents who can engage the affections, and whilst they excite a curiosity after knowledge, can gratify it in a pleasing manner, are the most natural instructors of childhood. When, however, they are either incompetent to the task, or are engaged in manual labour, infant schools are of great value, providing the greatest care and consideration be bestowed upon the choice of those who are to conduct

them. Early education forms the foundation necessary for raising a superstructure of scientific knowledge. By it the use of the necessary tools, reading and writing, is acquired, the memory is exercised, and the expansion of the intellectual faculties is carefully watched and gently aided. But something beyond this may be effected. There are many things connected with natural history which may be advantageously pointed out and explained to children; such as the adaptation of the forms of animals to their habits and wants, as exemplified in the webbed feet of aquatic birds, and the long beaks of woodcocks and similar birds, which enable them to penetrate marshy ground in search of their food; and the teeth and feet of animals of prey, as compared with those which are herbivorous. In a thousand ways of this kind the infant mind may be imbued with a taste for scientific pursuits. But the science of religion is that which it more especially behoves us to bring before children. We cannot make them comprehend its mysteries or doctrines, but we may exercise them in its discipline, and make them acquainted with the touching histories of that sublime and vivifying revelation which may in after years prove a "light to their feet and a lantern to their paths." Thus to instruct youth is a task of hope and joyful anticipation. As we witness the blending of religious impressions with the sunny dreams of childhood, we feel assured that when those dreams are recalled in after life, by the power of association, these impressions shall accompany them. They may either grow with the strength of our child into fixed and governing principles of action, or, having been smothered for a while by impressions of an opposite nature, they may yet again burst forth, and bring peace to his mind. To the parent who, with mildness and gentleness, has endeavoured to associate religious thoughts with the expanding feelings of youth, how consolatory must be the hope that they will, sooner or later, produce their effects, and ensure him an union with his child in that place where sin and sorrow shall for ever cease. From these considerations it follows that early education is a subject of the deepest importance, and that it forms a material part of that system which is calculated to improve the condition and raise the character of the inhabitants of large towns. The attention of the legislature seems at length turned to the subject, and I cannot but hail with delight that

clause in the bill which has been introduced by Lord Brougham, whereby provision is made for the instruction of the young in the whole unmutilated volume of Divine revelation. It is to be hoped, however, that whatever may be the efforts of the legislature, those of individuals or public bodies will not be relaxed ; but that each man in his family, and each sect in their congregation, will strain every nerve to raise the standard of religious affection and moral intelligence in the rising generation.

The *instruction of adults* may be forwarded by *cheap works, class teaching, and public lectures*. The publication of cheap works has increased in this country, of late years, in an extraordinary manner; and while the price has been reduced the quality of the matter they contain has been much improved. The Saturday's and Penny Magazines, the Mechanic's Register, and the Numbers published by the Society for the Diffusion of Useful Knowledge, all contain much information at a small price. At the same time, the works of Franklin, and other instructive books of the same kind, have in a great measure replaced penny romances and those low works of fiction which are calculated only to vitiate the taste, and to interfere with the proper culture of the mind. Above all, the pure Word of God, while it has been translated into almost every known tongue, and has been sent into every quarter of the globe, has been circulated to an extent unknown before, among persons of every class in this country. It may be hoped that each succeeding year and day will witness the fruits of such extensively scattered seed. But what has been accomplished in this manner bears but a small proportion to that which is required ; because this circulation of knowledge serves not merely to supply the demand for it which already exists, but to create others in an almost geometric ratio ; so that the more we do, the greater is the necessity for fresh exertions.

*Class teaching* possesses one great advantage over reading—the teacher is always at hand to explain difficulties which might otherwise prove insurmountable. By this means the reading and study of the members of the class are directed into a right channel, and thus much economy of time and industry is effected. In this town, a valuable society, formed among the mechanics themselves, has existed almost ten years, under the name of the Mechanics' Institute,



and one of its leading features is the class teaching which is attached to it. Four nights in the week their meetings are held, and instruction is given in mathematics and arithmetic, languages, drawing, &c. Our Curator, in his lecture on Meteors, detailed to you the result of the observations made by three young mechanics who formed a part of the mathematical class. Their report was highly creditable to themselves and to the institution with which they are connected. It looks well, indeed, when the working classes are found associating themselves together for the purpose of mental improvement, and I trust that they will receive continued and increasing support from their richer neighbours in so laudable an undertaking. Perhaps the best way in which money can be bestowed is in assisting the efforts of those who are striving hard for themselves.

The direct manner in which *Public Lectures* contribute to the diffusion of scientific knowledge is obvious. The facts and experiments from which the laws of science are deduced, being palpably exposed to the senses, bring with them a conviction which no reading could do; and being associated with time and place, they become strongly engraved upon the memory. For the purpose of insuring a uniform and steady supply of lectures in large towns, union is found not only to be advantageous but necessary. Hence, Societies are established, and in this town two such now exist—the Mechanics' Institute, to which I have before alluded, and the Philosophical Institution, the members of which are assembled here this evening.

The necessary appendages to such Societies consist in apparatus for making experiments and demonstrating facts connected with all the branches of natural philosophy, and a museum containing specimens necessary for the illustration of the natural history of the earth, embracing the mineral, vegetable, and animal kingdoms: a good library of scientific works, constantly receiving additions, is also required, to serve as a reference to the lecturers and to the members of the Institution. To trace the progress of the Birmingham Philosophical Institution, and to examine how far it has been enabled to accomplish its objects, cannot be out of place on this occasion, when those objects form the subject of the lecture.

It was established in 1800. The gentleman to whom it owes, if not its existence, at least its early prosperity, is Mr. GEORGE BARKER,

who is well known to most of us. To have mainly contributed to the establishment of a society of this kind, at a time when strong prejudices existed against the diffusion of scientific knowledge, is a proof of an enlightened and vigorous mind, and great energy of character, and should entitle him to the lasting gratitude of the inhabitants of this place. In the course of time, the interests of the Institution were advocated and advanced by many, amongst whom I may, without disparagement to others, mention the names of your President, Mr. JOHN CORRIE: your Treasurer, Mr. RUSSELL; and the late Dr. DE LYS and Mr. GEORGE PARSONS. To the labours of Mr. Parsons, as its Secretary, the Society owes much; never were perseverance, industry, benevolence of heart, soundness of judgment, and intellectual cultivation, more united in one individual than in him; and it will be long, indeed, before his loss will cease to be felt by us.

The operations of the Institution were conducted on a limited scale at its commencement. A small room, in an obscure part of the town, served for the assemblage of its members and the delivery of lectures. By degrees, however, it has assumed a more imposing aspect; and we now find ourselves in a comfortable little theatre, and in possession of some good apparatus for experimental philosophy, and of a collection of geological specimens, which has already swelled beyond the limits of the only room which can be devoted to its reception.

Since its establishment, lectures have been delivered to its members by Drs. Dalton and Thompson, and Mr. Richard Phillips, on Chemistry; by Sir James E. Smith, on Botany; by Messrs. Webster and John Phillips, on Geology; by Mr. Campbell, on Poetry; by Mr. Taylor, on Music; by Mr. Scoresby on Magnetism; by Mr. Addams, on various subjects; and by many other public lecturers. Lectures have also constantly been delivered by the Fellows of the Society, amongst which I may mention those by Mr. John Corrie, Dr. De Lys, and Mr. Baddams. Those of your President are said to have possessed the rare merit of simplicity, even when their subjects were such as are generally considered abstruse; evincing the results of a brilliant imagination and a powerful mind, and conveying both pleasure and instruction to his audience.(a)

(a) Mr. Corrie is now no more.—He lived to see his eloquent appeal to the members of the British Association at Liverpool, crowned with success, by their consenting to hold their

There are two circumstances connected with the lectures delivered before this Institution which demand especial notice. I am informed that the Society of Arts arose out of a very clever and beautiful lecture on Design, written by Mr. Richard Lawrence, a Veterinary Surgeon, and read before the members of this Institution by Dr. Bright. But this is not all. Twenty-five years ago, the spot on which I now stand was occupied by one in whom strong powers of mind and acuteness of perception were joined to great benevolence of heart. He pointed out in forcible language the forlorn and hopeless condition of those unfortunate persons who, "although endowed with the same powers, feelings, and privileges as ourselves," had been deprived of the faculty of hearing, and consequently of speech, and "were thus excluded from their natural share in human rights, and degraded in some sort from their rank as human beings." He showed how they might be rescued from this forlorn condition, so "that the same sources of knowledge, and the same books from which we receive instruction, might be open to them, whether for the exercise of their mental powers, for inculcating the precepts of morality, or for unfolding the truths and hopes of religion." The Lecturer was Dr. De Lys. Beside him stood a little girl, deaf and dumb from her birth, to whose instruction his friend, Mr. Alexander Blair, and himself, had given considerable attention. I find it recorded that "the audience at the lecture were much interested by this little child. Her appearance, indeed, was remarkably engaging. Her countenance was full of intelligence, and all her actions and attitudes in the highest degree animated and expressive; while the eagerness with which she watched the countenances of her instructors, and the delight with which she sprang forward to execute or rather to anticipate their wishes, afforded a most affecting spectacle."

Strange would it have been had the audience not been deeply interesting in Birmingham this year. We followed him to the grave on the day when the first meeting of the Council of the Association was held in this place, and many of its members joined us in paying this tribute of respect to his memory. Possessing great powers of mind, he had successfully cultivated various branches of knowledge, and was enabled to communicate to others the fruits of his own labour with rare perspicuity, and simplicity.

Respected for his talents, he was no less beloved for his benevolence of disposition, and for the frankness and affability of his manners. His death has made a void in the literary society of this place, which will I fear remain long unfilled, and has spread a gloom over the meeting of the British Association, which many find it difficult to dispel.



terested ! for what could have been more calculated to call forth all the warmest feelings of the heart, and the strongest sympathies of our nature ? The matter did not rest here : the enthusiasm of the town and neighbourhood was lighted up ; and there now stands an Institution for the Instruction of the Deaf and Dumb, a lasting monument of the utility of the Birmingham Philosophical Institution. I take my stand here, and contend that if no other instance of its utility could be adduced, this one alone were sufficient to entitle it to the cordial support of every well wisher to mankind. I do not mean to say that the spectacle would have been less interesting in any other room than in this, or that the arguments would have been less sound and convincing if they had been brought forward elsewhere ; but it is more than probable that the attention of these benevolent and talented gentlemen had been directed to the subject by their scientific researches connected with this Institution. At any rate it was made the medium of communication with the public, and out of a lecture delivered to its members arose the valuable Institution to which I have alluded.

The Birmingham Philosophical Institution has also given a spur to the *promotion* of scientific knowledge. The statistical tables of mortality and of steam power, and the meteorological journal, contained in the Report for 1836, are highly valuable documents. The latter was kept by means of the self-registering anemometer and rain gauge. This instrument, which excited so much attention at the last meeting of the British Association for the Advancement of Science, (as being something which had long been wanted, but never till then supplied,) was invented by Mr. FOLLETT OSLER, in consequence of his having learnt the want of such an instrument at a meeting of the members of this Institution. It has been fixed on these premises, and you will be pleased to hear that the British Association has voted a sum of money for the erection of a similar one at Plymouth, and that the French Institute have sent for plans and drawings of it, for the purpose of testing its utility at Paris. It is indeed a beautiful instrument ; combining time with meteorological observations, and causing the wind and rain to record their own operations.

Now, in reviewing the past history of this Institution, we cannot but see that much has been done for the diffusion of scientific knowledge, and something for its promotion ; and to those who, after having

watched over its interests and forwarded its objects during a long course of years, are now arrived at the autumn of their days, the recollection of the past must be highly gratifying. But we, who are in the spring or summer of life, must not confine our view to the past; we must compare the present state of our Society with the wants of the town, and examine whether it yet contains all the necessary means for the furtherance of its objects. In short, we must take up the work which our elders have so well begun, and carry out their designs more and more. In doing this, our first attention must be directed to its management; for if that be defective, or conducted upon wrong principle, the actions which flow from it must partake of its taint. The Managing Committee is elected every year by the Subscribers, from their own body; so that the Society can refuse to re-nominate any member of the Committee in whose judgment or conduct they may no longer have confidence. I have been sufficiently long upon this Committee to enable me to speak decidedly as to the intentions of its members, and the spirit which pervades their councils. Actuated by no narrow or sectarian views in politics or religion, their sole aim is to carry out fully, and without reserve, the great objects of the Institution—the diffusion and promotion of scientific knowledge. Had I detected the least trace of an opposite spirit, I should have immediately withdrawn myself from them, as I will never consent to be mixed up with the extremes of any party. But I know that their motives are good, and they court the fullest and most searching enquiry into their actions.

Our attention must be next turned to the state of the building, museums, apparatus, &c., &c. The building in which we are now assembled is found to be perfectly inadequate to the wants of the Institution. Many of the geological specimens, which are every day pouring in upon us, are still unpacked, as there is no room for their reception. There is no museum of zoology or comparative anatomy; there are no instruments for studying the phenomena of the heavens; and the apparatus for experimental philosophy, though very good in some departments, is in others equally defective. Library there is none; for we can hardly take any account of those few old books which are at present on the shelves of the Museum. It is evident, therefore, that the Birmingham Philosophical Institution must receive much more extended and liberal support before it can effectually attain its objects. This is not a pleasing picture, but it is a true one;

and it will be contemplated with pain by the members of the British Association, who will form their estimate of the intellectual character of the inhabitants of this town by the degree of encouragement which is given to its scientific institutions.

In the Lecture to which I have referred at some length, Dr. De Lys exhibited the nature and extent of one source of human misery, and at the same time demonstrated the possibility of providing an efficacious remedy. The result was, that a remedy was provided for this town and neighbourhood. In all that has been brought forward this evening, the alarming nature and extent of the evils resulting from ignorance may be clearly traced; and the advantages arising from their removal, by the diffusion of scientific knowledge, will, I should hope, have been fully recognised. It has been shown that the Birmingham Philosophical Institution was established for the furtherance of this object, that up to the present time it has effected much, and in future it might be expected to do still more, were it liberally supported. Shall its means of utility, then, be enlarged? and shall it henceforward receive encouragement and support worthy of this great town? When I compare the feeble efforts of him who now addresses you with those which must have been exerted on the memorable occasion to which I have alluded, I will own that I despair; but when I look to the *cause* for which I plead, I entertain a hope, or rather a strong confidence, that I, also, on this occasion, shall not speak in vain. My hope is to see arise a substantial and spacious building, containing a theatre capable of accommodating an increased number of members, and apartments that shall not merely serve for the accommodation of our Curator, and for the reception of the apparatus and specimens which are at present in the Museum, but of those also which the liberality of the friends of science, or the increased funds of the Institution, may provide. (a) It has often been remarked that the societies for the encouragement of literature and science in this town are too much scattered; and it has been suggested that an union of some of them, for the purpose of erecting a

(a) The buildings of the Philosophical Institution have now undergone a thorough repair, accommodation has been furnished for the Curator, and an excellent room has been built and fitted up as a geological museum, in the arrangement of which the talent and industry of Mr. Iek, may be clearly traced. The formation of a scientific library has been commenced with every prospect of success, and a very large additional number of persons have enrolled themselves as members, among whom are some of the most distinguished persons in the neighbourhood.



building which should contain separate accommodation for each society, would be highly desirable. Another handsome edifice might then be added to those already adorning our town, and increased facilities afforded for the furtherance of the objects which these societies have in view. I do not, however, consider myself capable of giving an opinion as to the practicability or working of such a plan.

To those who are already members of our Institution it would be quite superfluous to address a word in the shape of an appeal for greater exertions in its behalf. Of the necessity for these, at this particular time, they are well aware. There are, however, others here this evening who are not enrolled in our list of members, but who, by their presence, evince an interest in the subject. To such, and through them to the inhabitants of the town at large, I may be allowed to address a few words. To those among them who have become possessed of wealth, either by inheritance or by personal industry, I would suggest that a connection with scientific institutions is one from which they cannot but derive pleasure, and may derive improvement. It is a pleasure, as well as a duty, to employ that wealth which the bounty of Providence has bestowed in so noble a work as the diffusion of scientific knowledge; and if their attention shall be turned, by having engaged in its diffusion, to the acquirement of that knowledge for themselves, their gain will be great indeed. They will also find it to their interest. The surest protection to property will be found in the removal of ignorance and the extension of mental improvement among the labouring classes. Taught to reflect, and to trace the connection between cause and effect, they will soon learn to protect the property of others, and to create it for themselves by honest industry and thrifty management. The legislature has done much towards raising a barrier against imprudence and dishonesty, and thus stemming the tide that would soon have swept into the vortex of idleness and profligacy the property of the honest and industrious: but the completion of the cure must be effected by the improvement of the moral feelings of the working classes, and by their increased mental cultivation.

By these means our glorious constitution will be safely and soundly renovated, and its pillars and bulwarks will be so strengthened that the Gothic pile shall be supported in all the freshness of its youthful days, and shall be effectually defended against the assaults of its bit-

terest foes. For, as there can be no greater evil in the state, than an increasing estrangement between the different classes of society in feelings and thought, so there is no surer test of its soundness and stability than a gradual approximation between them in these respects. If successive governments have hitherto neglected to extend efficient support and encouragement to Science, there is the greater necessity for the redoubled exertions of individuals, in order that their deficiency may be counterbalanced, and that they may be shamed into the adoption of a more enlightened policy.

On the manufacturer, the Philosophical Institution has a strong claim for support. He owes every thing to Science. There is not a piece of machinery he makes use of, or a process he employs, which has not resulted from scientific investigation, whether conducted by persons devoted to abstract Philosophy, as instanced in the invention of the safety lamp, by Sir Humphrey Davy ; or, (which is still more to the point,) by mechanics who have acquired for themselves some knowledge of its truths, as was done by Arkwright during the time he was perfecting his cotton spinning machinery. If no other persons would come forward and place this Institution on a footing worthy of this large and populous town, the class of manufacturers might be expected to do so. They will receive an abundant return for all their capital embarked in the diffusion of knowledge ; for it will be the means of removing the ignorance which has led to those combinations of workmen, and that destruction of machinery, which have proved so ruinous to all parties.

I appeal, however, to higher motives than these. If you value the approbation of conscience, you will not neglect so great a duty. If you are animated by love to your MAKER and to your fellow-creatures, you will use your utmost exertions to diffuse widely that light which brings more clearly into view HIM from whom it emanates, and which cannot fail to improve those on whom it shines. In a word, if you would live to the glory of GOD, and to the benefit of man, you will labour by such means as I have pointed out, by laying early the foundations of knowledge on religious instruction, and by building thereon the beautiful edifice of "Science truly so called," to elevate, intellectually and morally, the multitudes that are around you, in this town and neighbourhood.